

## REMARKS

Claims 2-15 and 17-24 are active. Claims 1 and 16 are canceled. The claims were subject to restriction wherein claims 2-16 were withdrawn from consideration as being directed to a non-elected invention. That restriction is withdrawn in the instant Action.

Applicants thank the examiner for his constructive comments.

The drawings are objected to. The specification is objected to. The abstract is objected to. The disclosure is objected to. Claims 3, 9, 12, 17 and 21 are objected to based on formal matters. Claims 2-3, 5, 14-15 and 23 are rejected under 35 USC 112, first paragraph. Claims 2-13, 18 and 23 are rejected under 35 USC 112, second paragraph. Claim 12 is rejected under 35 USC 102 as anticipated by Sirringhaus ('669). Claims 17-23 are rejected under 35 USC 103 as being unpatentable over Drury '024 and Schmidt '881. Claims 17-24 are rejected under 35 USC 103 as being unpatentable over Sirringhaus in view of Schmidt. Claims 4, 6-11 and 13 are rejected under 35 USC 103 as being unpatentable over Murakami in view of Drury. Claims 2-3, 5 and 14-15 are rejected under 35 USC 103 as being unpatentable over Murakami, Drury and Schmidt.

## INFORMAL MATTERS

### The Abstract

The Abstract has been amended as requested as to deleting the reference to Figure 4. The objection to the so called first sentence is in error. The so called first sentence is the title of the invention and as such does not require punctuation as

requested. The Abstract is a single paragraph excluding the title which is not part of the abstract text per se.

#### The Drawings

The drawings are objected to, mainly Fig. 7 because the reference numeral 5 in the specification is missing. This is not a drawing error, but a typographical error in the written description. There is no layer 5 in Fig. 7, but two layers 4. The specification is amended to delete the reference to reference numeral 5. The drawing Fig. 7 is now acceptable.

#### The specification

The specification has been amended as noted above to remove the reference to layer 5 missing in Fig. 7. The so called first sentence is the title and not part of the specification per se. The requested punctuation is inappropriate in the title. Minor amendment is made to the specification to delete the term "location" in reference to the disruption element in certain of the paragraphs. This is a translation error as it should be plain it is the disruption element that is being referred to and not a location as amended.

#### The claims

Certain of the claims have been amended to meet the objections based on the formal matter issues. Other amendments are made to meet the objections thereto and to improve the form of the claims. No new matter is introduced. While certain of the objections are based more on personal style of the Examiner with respect to grammar and form, which are not objectionable, some of the suggested changes are made to advance the prosecution of this application. For example, where one of ordinary skill would understand what prior element is being referred to, the claim is clear on its face

and is not objectionable. This comment refers to the objection to the claim 11 term PP. This comment also refers to the objections to claim 17, for example, and others of the claims wherein all modifiers of a claim need not be repeated verbatim every time that element is presented when the claim is other wise clear as to which element is being referred to. This requirement improperly exalts form over substance.

As to claim 11, the Action objects to the term PP as meaning numerous different things. This is traversed as not true. Enclosed is a copy of Wikipedia (Google) for the term PP. As can be seen from the attached, PP is a common term referring to polypropylene, a thermoplastic polymer. This objection should be withdrawn. The specification is amended to include the subject matter of this claim which is an appropriate amendment, as claims are part of the disclosure.

The objection to claim 21 is traversed. The suggested change in the Action changes the intended meaning of the claim elements and is inappropriate. This claim is acceptable as is.

Claim 21 presently calls for:

The component of claim 17 wherein the first and second plurality of layers form further lower layers and upper layers, the through plating decreasing in diameter as the through plating extends from a lower layer to an upper layer.

The Action requests that this claim be amended as follows:

The component of claim 17 wherein the first and second plurality of predominantly organic functional layers form further lower layers and upper layers, the through plating decreasing in diameter as the through plating extends from a lower layer to an upper layer.

However, claim 17 calls for

a first plurality of layers including a second plurality of predominately

organic functional layers

The first plurality of layers in claim 21 as proposed by the Action is now being described as predominantly organic functional layers. This is not according to claim 17 and is wrong. In claim 17, it is the second plurality of layers that are predominantly organic functional layers, not the first plurality. The objection to claim 21 exalts form over substance. This claim is not indefinite and is clear on its face to one of ordinary skill. Claim 21 refers to the first and second plurality of layers in claim 17. Such layers are clearly defined in claim 17. That is all that 35 USC 112, 2<sup>nd</sup> paragraph requires.

For the reasons given, the objections to the claims, specification, drawings and abstract based on certain formal matters have been met and this basis of the rejection should be withdrawn.

35 USC 112, first paragraph rejections of claims 2-3, 5, 14, 15 and 23

Claims 2-3, 14-15

The Action states that:

- a. the specification does not disclose the combination of elements including the disruption element and the truncated conical cross –section profile of the through plating.
- b. The truncated conical cross section profile of the through plating is disclosed in the embodiment of Figures 1-7 which does not have the disruption element.
- c. The disruption element is disclosed in Fig. 8 which does not show the truncated conical cross section profile or the through plating.

Applicants respectfully traverse this rejection as exalting form over substance and that it implies that one of ordinary skill is without common sense in understanding

applicants disclosed teachings as explained in prior responses filed by applicants and further discussed below.

Figures 1-7. The Action states these do not show the disruption element. This is incorrect. Reference is made to the specification page 6, lines 3-32, which explains the various embodiments of the so called disruption element.

1. The disruption element prevents wetting of the lower conductor layer 2. Page 6, lines 4-5. Holes are produced in layers which are to be through plated. Page 6, line 6.

a. the disruption element can be a material, page 6, line 12.

b. The disruption element can be a change in the physical/chemical properties of the surface of layer 2, and which surface properties are altered, page 6, lines 15-16.

Thus, it is plain to one of ordinary skill to whom the specification is directed, that the substrate layer 2 of Figs. 3-7, may have either a physical discreet disruption element 7 on it as shown in Fig. 8, for example, or a change in the surface properties on the surface of layer 2 that prevents that surface from being wetted by the subsequently applied layer 4 and not needed to be shown in the figure 7. A chemical property change normally is not depicted in a drawing figure. The latter condition means that a void is created in the layer 4 as layer 4 is applied to the layer 2 in the region of the change of surface properties of the layer 2, i.e., layer 4 does not wet the surface of layer 2 as the layer 4 is applied in the area of the disruption element. This void is represented by the through plating 3 that extends from the layer 2 through the layer 4 as shown in figures 3-7. This void is explained in detail throughout the specification.

One of ordinary skill would understand from applicants' above disclosure that

there is a void in layer 4 produced by a disruption element on layer 2. This void is produced regardless of whether that disruption element is a physical material, that may or may not be later altered, such as element 7 of Fig. 8, or a chemical change in the properties of layer 2, and thus is not expressly depicted in Figs. 3-7, but present on that layer 2 nevertheless by reason of the fact that the non-wetting action produces a void in layer 4 which is shown in the various figures. This is notwithstanding that the through plating 3 is also shown. It should be understood by the disclosure of the specification that the through plating is, later on in the process, located in the void or hole in the layer 4 produced by the disruption element when the layer 4 is deposited, but not deposited in the area of the non-wetting action.

That chemical property is not, nor need it be, physically shown in the figures 3-7 for one of ordinary skill to understand what is occurring and that is all that 35 USC 112, first paragraph requires. Nevertheless it is plain that such a void so created by the non-wetting chemical surface properties of layer 2 in the region of interest, would be understood by one of ordinary skill to be intended to be present in the drawing figure by the specification. That chemical property is not, nor need it be, physically shown in the figures, but still is present as a property. Material properties are not typically of such a nature that they need be or can be depicted in a figure. For example, a property of material is hardness, softness and so on, which is not readily depicted by a physical drawing. That property of preventing the layer 2 from being wetted by the applied layer 4 is present in the layer 2, even though it is not depicted expressly in the drawing. Such depiction is not necessary. That property, while present but not shown in figures 3-7, prevents the layer 4 from adhering to the layer 2 in the designated areas depicted by

the through plating 3 creating the void in layer 4.

The very presence of the through plating 3 by way of explanation in the specification, is located in a void in the layer 4 produced by the disruption element on layer 2, whether that element is of the type depicted in Fig. 8 as a physical element or as a material property as depicted in Figs. 3-7, it matters not which. Common sense of one of ordinary skill, based on the specification and drawings in their entirety, shows that the so called void in layer 4, in which the through plating 3 is located, was created previously by the disruption element as the layer 4 was deposited. This is true whether or not such element is shown in these figures. Such a showing is believed not needed for a complete understanding of the disclosure. The disclosure satisfies 35 USC 112, first paragraph as to these claims. This basis of the rejection is believed in error and should be withdrawn.

#### Claim 5

The Action states that the rough surface of the through plating and the combination of the disruption element are not disclosed in the specification. Applicants disagree. However, claim 5 does not call for a disruption element so this rejection confuses claim 13 with claim 5, from which claim 5 depends. Figs. 2-7 all show the through plating 3 as having a jagged upper surface manifesting the so called rough surface. The surface roughness is discussed in the specification at page 4, lines 21-22. This rejection is not proper as to this structure.

As to the presence of the disruption element, this is discussed at length above in the preceding paragraphs. However, claim 5 only calls for the through plating to have a surface roughness. It does not call for the disruption element per se. This is in claim 13

wherein the discussion above regarding the disclosure of the disruption element is discussed in regard to others of the claims and is equally applicable to claim 13. This rejection should be withdrawn.

#### Claim 23

The Action states that claim 23 adds a third plurality of layers that the through plating extends through. However, the Action states that more layers are introduced than disclosed. Applicants disagree. Below are the respective claim portions with reference numerals added referring to the various claimed layers of Fig. 7 by way of example. As is plain, claim 23 is correct as shown in certain of the figures.

Claim 23 depends from claim 17.

Claim 17 calls for:

a first plurality of layers (1, 2, 4, Fig. 7) including a second plurality of predominately organic functional layers (there are two organic functional layers 4 shown, page 5, line 13) at least one of the first plurality of layers is a first lower layer (2) and at least one other of the first plurality of layers is a central layer (4, the lowermost of the two layers 4 in Fig. 7);

Claim 23 calls for:

wherein the through plating extends through each of a third plurality of layers (1, 2, 4 –upper half of figure 7) different than the first lower layer (2- of the lower half of figure 7) and is coupled to the third plurality of layers though which the through plating extends, (the through plating extends through the upper layer 4 and is coupled to the upper layers 2 and 4 of Fig. 7)

Thus, claim 23 is proper under 35 USC 112, 1<sup>st</sup> paragraph. This basis of the rejection should be withdrawn.

#### Claims 2-13, 18, 23 35 USC 112, 2<sup>nd</sup> paragraph.

The term "product" is amended in claim 13 to – component – . The rejection of



various ones of these claims as referring to a component not recited in claim 13 is believed met.

Claims 3 and 4 are amended to list the elements in Markush format.

Claim 5-ohmic contacting. The Action states it is not clear what is ohmic contacted. The claim calls for the through plating to have a surface roughness that promotes ohmic contacting. Obviously the ohmic contacting is to the through plating surface roughness. The claim is directed to one of ordinary skill who would plainly understand what promoting ohmic contacting means in terms of providing a surface roughness that promotes such contacting. Ohmic contacting means a resistance contact to enable electrical currents to flow through the contact region, which is a well known phenomena. The rough surface of the through plating is sufficiently rough as claimed as to promote good electrical conductivity thereto. That is all that is meant and that would be so understood by those of ordinary skill. It is clear that it is the rough surface that is ohmic contacted. Fig. 7 shows two such through platings contacting one another at their respective roughened surfaces depicted by the jagged surfaces thereof. This claim is clear and definite.

Claims 6, 7 and 9– The Action states that it is not clear what is meant by the disruption element as manifesting a chemical treatment or equivalent terminology. This is plain ordinary garden variety English. The disruption element is represented by a chemical treatment. The term “manifest” means - - represents- - . There is nothing esoteric about the term manifests in this context. The disruption element comprises a chemical treatment of the underlying material such that a subsequently deposited layer does not wet the underlying material where treated. This too is common sense.

Claim 7- The lower functional layer term at line 3 is objected to as having no antecedent basis. Line 2 recites that the first layer comprises a lower functional layer. This is sufficient antecedent basis and this objection is in error.

Claim 11 The term PP is deleted to advance the prosecution of this application. It appears that the Examiner believes it relates to a number of materials. There is nothing wrong in a term referring to a number of materials having a common abbreviation.

#### Claim 12

This claim is amended to meet certain of the objections thereto. As to the term "at least a second portion of layers are ohmically intercoupled by the through plating," the Action states this term is indefinite as it is unclear what a second portion of layers are coupled to. It is believed that the amendment to this claim meets this objection. As to the term majority, this is garden variety English. A majority refers to more than 50%. This term is plain and definite on its face. The Action is not clear in stating: "it is unclear what 'a majority ' is" [a majority is more than 50%] "and whether layers not in this 'majority' also include the an insulating layer, first layer, subsequent layers, disruption element, void, and through opening." As far as understood, the term "majority of which layers" means more than 50% of the claimed plurality of layers comprise predominantly (more than 50%) organic material. It is not understood what is unclear about this term. The specific named layer material is not understood as to their relevancy to what is claimed. This goes to claim construction and not to clarity of expression.

The Action queries as to whether layers not in this majority also include an

insulating layer, first layer, subsequent layers, disruption element, void and through plating. Claims are not construed in a vacuum. The specification makes clear by the embodiments disclosed as to what these terms mean. This issue relates to claim construction and not to clarity of expression. The claims can be construed to mean whatever falls within the language of the claim terms. The specified layers in the Action as to a possible construction of the claim are not relevant to whether the claim is clear and definite.

The layers not in that majority are not predominantly organic material, i.e., they are inorganic, silicon, metal etc. This is clear from the claim. (it is not understood how a void can comprise anything, that is impossible). Any material that is not predominantly organic could be included. Breadth of a claim is not equivalent to being indefinite. The insulating layer is organic and the claim is amended accordingly. It is believed that the claim as amended meets this basis of the rejection and which should be withdrawn.

#### Claim 13

This claim is amended to meet the objections thereto. The term "at least two of the layers" is objected to as unclear. This term is amended and is believed clear on its face as amended.

#### Claims 18 and 23

These claims are amended to meet the objections thereto.

If the Examiner believes that there are other matters not addressed by the amendments and discussion regarding the issues discussed thus far, he is invited to call the undersigned to address these issues.

One of ordinary skill would understand the various claims as discussed and

construe them properly and that is all that is required by 35 USC 112. The MPEP also concurs that where claims are clear on their face that objections need not be met with amendments. See the MPEP 2173.02 page 2100-219 where it is stated an applicant does not have to adopt the examiner's suggestions made based on personal judgment.

The substantive rejections

Amended Claim 12

This claim is rejected as anticipated by Sirringhaus '669. This claim calls for:

A process for the production of at least one through plating of an electronic component comprising:

forming a plurality of layers including a first lower layer, a majority of which layers are of predominantly organic material and which organic material includes an insulating layer, the forming of the first lower layer being followed by forming subsequent layers deposited sequentially on the first lower layer,

the forming of the first lower layer including forming a disruption element on the first lower layer which element is arranged to result in a void in at least a first portion of subsequently deposited layers on the first lower layer, and then forming a through plating in the resulting void wherein at least a second portion of layers of the subsequently deposited layers are ohmically intercoupled to each other by the through plating (underlining added)

Sirringhaus is foreign to this claim especially the underlined portion. This reference describes a method of building a through plating by putting on top of a plurality of layers a drop of solvent, which dissolves all of the lower layers on the way down to the substrate. This is not what is claimed. No disruption element is on a first lower layer which element is arranged to result in a void in at least a portion of the subsequently applied deposited layer on the first lower layer. The disruption element creates a void in the later deposited layers. The Sirringhaus reference does not work as claimed.

The Action argues that the claim term "to result" is intended use. This is a

method claim. This point is not true, and is irrelevant to what is claimed. There is no disruption element on the lower layer of the reference that causes or results in a void being formed in the later deposited layers. Claim 12 is a method claim and the claimed steps are missing in the reference which creates a void in all of the applicable layers by dissolving them after the layers are formed and not by preventing the layers from wetting the lower layer, for example, when applied. There is no forming of a disruption element on a lower layer prior to deposition of the subsequent layers. All layers of the reference are deposited before the solvent is applied. The solvent is not the claimed disruption element on the lower layer. It is not even on the lower layer as claimed, but applied to the upper layers first. This is different. The remaining references are believed equally foreign to this claim. This claim is believed allowable.

Claim 17-Drury and Schmidt, Sirringhaus and Schmidt

Amended claim 17 calls for:

An electronic component comprising:  
a first plurality of layers including a second plurality of predominately organic functional layers, at least one of the first plurality of layers is a first lower layer and at least one other of the first plurality of layers is a central layer; and

at least one through plating having a truncated conical cross-sectional profile which extends from a wider region at the first lower layer through at least the central layer transversely to the central layer to a narrower upper region spaced from the lower layer, the at least one through plating having a truncated conical cross section profile extending at least in part below the central layer and is electrically coupled to at least two layers of said first plurality of layers and second plurality of predominantly organic functional layers.

This claim was rejected as unpatentable over Drury and Schmidt prior to amendment. However, Drury does not extend from a wider region at the first lower

layer to a narrower upper region spaced from the lower layer as claimed, and neither does Schmidt, which has the tip of a pointed arrowhead at one of the termination points. Drury is missing this structure. Schmidt is also missing this structure. There is no truncated conical cross sectional profile in either reference which extends from a wider region at the lower layer to a narrower upper region spaced from the lower layer as claimed. The claim in addition calls for the following more particularly.

at least one through plating having a truncated conical cross-sectional profile (underlining added)

This claim structure is not shown, suggested or otherwise disclosed by Drury '024 and/or Schmidt, alone or in combination. '024 discloses a vertical interconnect area 104 in a laminate comprising a stack 10 of areas 3-6. A tapered tool tip 20 has a radius 21 at angle 22, Fig. 4, (col. 4, line 58-col. 5, line 18) forming a notch. Since the tool tip 20 is tapered and has a curve formed by a radius 21 (col. 5, line 6), the interconnect area by definition must be conical, i.e., a cone. See Fig. 2 wherein the plan view of the interconnect area is circular. Obviously a circular in section tapered region defined by the conductive layer 6 of Drury defines a cone, not a truncated cone as claimed. These are different structures.

The claim calls for a truncated cone which is not shown or disclosed or otherwise described by Drury as admitted by the Office Action in citing Schmidt as disclosing a truncated cone, which is also not disclosed therein as discussed below. The Drury reference is foreign to amended claim 17.

Schmidt is of no help and is cumulative with Drury. The Action states that Schmidt teaches a truncated conical cross sectional platings as elements 11, 11', Fig.

2g. Applicants disagree with this conclusion in that the Action is selecting only so much of the reference that meets a rejection while ignoring the rest of the related structure. This is improper. The elements 11, 11' are not truncated conical shapes (frusto-conical) but are arrows attached to circular cylinders. These are totally different from what is claimed. The Action does not present a reasonable convincing line of reasoning as to why the arrow shaped configurations of Schmidt are deemed truncated conical in shape. The Examiner is respectfully requested to research the shape of a frusto-conical element in the published literature, and which is not shown in the cited references.

The elements 11, 11' have two portions, a top portion and a lower shank portion on which and to which the top portions are connected and part of. The top portions are conical in the form of an arrow head and are not frusto-conical in shape as claimed. But there is also a bottom portion connected to the top portion and that is circular cylindrical. These two portions need to be considered as one structure and not as separate structures. There is no motivation to combine the references as suggested and if combined they do not suggest what is missing in both references. They are totally different constructs not otherwise related to one another. Schmidt works with pressed and laminated conductor foils and Drury uses a tool to form the shape desired. There is no nexus between these references and the shapes of the structures formed other than that suggested by applicants. It is improper to combine these references based on their disclosures, which are irrelevant to one another in the context of applicants' claim. The reference to Schmidt col. 4 and Drury col. 2 have nothing to do with the conclusions asserted. More importantly no truncated conical through plating is suggested by either reference.

The recesses 3, 3', are described as circular windows, col. 2, lines 32-33, which are thus circular cylinders and not frusto conical. They also may be rectangular and not even circular, but grooves, lines 37-38. There is no truncated conical shape disclosed, much less as claimed. The bottom circular cylinder is not truncated conical shape and neither is the top arrow head portion. However, these portions whether separate or combined do not form the claimed structure. The top and bottom portions are not truncated cones and neither is their combination such a shape, which is more complex than the top and bottom portions alone and certainly not frusto-conical as claimed. This argument was previously presented in applicants prior response and no satisfactory reasoning is given in the present Office Action addressing these prior comments. These references are foreign to claim 17 and taken singly or in combination, and do not disclose or suggest claim 17, which is believed allowable.

Sirringhaus is admitted by the Action as not disclosing the claimed truncated conical cross section as claimed. Schmidt again is erroneously cited as disclosing such a structure. It is improper to piecemeal dissect the structure of the Schmidt reference to meet a given need. The elements of Schmidt in their entireties as asserted as comprising the claimed through plating in fact are of a totally different shape. Schmidt does not teach or disclose a conical truncated through plating as asserted. It is error to ignore express limitations. These claims are believed allowable.

#### Claim 13-Murakami and Drury

Claim 13, amended, calls for:

An electronic component comprising:  
a first layer;  
a disruption element on a portion of the first layer over a given region of the first layer;



a plurality of layers applied to the first layer, at least a first portion of the plurality of layers comprising predominantly organic material;  
the disruption element being arranged to result in a void in a second portion of the plurality of layers in the area above the disruption element when the plurality of layers are applied to the first layer including the disruption element; and  
a through plating in the resulting void for forming an electrical interconnection to at least two of the plurality of layers. (underlining added)

The Murakami reference discloses a method of mounting a semiconductor on a circuit board not related to the above claim. Murakami is cited as disclosing a disruption element comprising physically or chemically roughened surfaces. These are roughened mounting surfaces or pads for mounting bump electrodes for interconnection to the semiconductor mounted on a substrate, a circuit board. Col 5, lines 8-11, and are formed by sand blasting or otherwise. This roughened surface is not disclosed as corresponding to a disruption element in the context claimed. As claimed, the disruption element is arranged to result in a void in a second portion of the plurality of layers in the area above the disruption element when the plurality of layers are applied to the first layer including the disruption element. This is a means plus function limitation. The means are the disruption element. The function as underlined is what follows. The entire board of the reference is sandblasted. C. 3, L 54-60. After the roughening process, the mounting pads to which nickel platings 3 are applied are the only structures on the circuit board. Col. 4, lines 33-37. Electroless gold platings are applied to the nickel. C. 4, L. 38-40. A sealing resin 7 is applied to the mounting portion of the circuit board. C. 4, L. 50.

There is no disclosure that any surface roughness on the circuit board or contact pads creates a void in a later applied layer. The examiner is respectfully requested to supply support for such if he continues this rejection.

The Action states the epoxy element 7 is formed above the first layer of functional organic material. It is assumed this first layer is the circuit board 1. A through plating 9 is in the void. However, the Action does not state how this so called void is created. It is not created by applying the epoxy 7 over the contact pads 2 as claimed. There is no support in this reference for this conclusion. Merely spreading the epoxy around the pads 2 does not meet what is claimed and is irrelevant. The epoxy 7 is not disclosed as being applied to the so called roughed surfaces of the pads above which the Action states are the so called voids.

The fallacy of the conclusions of the Action is that there is no teaching in this reference that a layer is applied to and above the roughened surface, a so called disruption element as claimed, that is arranged to result in the void. The reference is silent as to the reason for the presence of the so called void and appears by common sense that the sealing resin 7 is merely spread about and around the pads 2 onto the circuit board and is not applied to the contact pads, and thus is irrelevant to what is claimed. The sealing resin is applied to a mounting portion of the circuit board 1 and not to the pads. C. 6, L. 53-57. The resin 7 is applied by screen printing which is selective as is known in this art and thus is deliberately not applied to pads 2 which would make them non-functional for receiving gold plating.

This is not what is claimed. However, in Fig. 1G, the element 7 is placed between the elements 2 and is not applied over these elements as claimed. The claimed void must result when the element 7 is applied to the so called roughened surfaces of elements 2. This creation of a void is not true in the reference since the entire circuit board is roughened as noted above and the sealing resin 7 is applied by screen printing

in selected areas excluding the pads 2. Therefore the roughened surfaces are irrelevant to preventing the deposition of the element 7 thereon. These conclusions of the Action are not based on the reference, but hindsight reconstruction based only on applicants' teachings. This rejection is improper.

The roughened surfaces do not serve as disruption elements as claimed and do not form voids or prevent subsequent layers from being applied thereto. Applicants fail to find support that the roughened surfaces prevent the deposition of any subsequent layers thereon corresponding to the underlined portion of this claim.

This reference is not relevant to this claim. Some of the contact pad surfaces of the reference are also nickel plated and protected from the roughening step such as sandblasting by a protective resist 4. Electroless gold plating is applied to roughened platings. C. 4, L 36-40. No disruption element is disclosed to result in a void in a portion of layers applied to the area on and above the disruption element. The relevance of Murakami is not seen. If the Examiner persists in this rejection he is respectfully requested to identify with particularity the relevance of this reference to claim 13, as applicants find no such relevance.

There is no disruption element disclosed such as to produce a void in later applied layers as per the underlined portion of claim 13 above, much less a through plating in such created voids.

The intended use discussion is irrelevant also. The Action states that the phrase "for forming an electrical connection " does not distinguish the claim over the cited art. The through plating forms an electrical connection and this is not an intended use function but a structural element wherein the through plating is arranged to form such

an electrical connection. This is not an intended use as asserted. Forming an electrical connection is not an intended use, but a functional description of the function of the through plating, it serves as an electrical interconnection.

Drury is equally foreign to this claim as well as this reference is not cited for disclosing the claimed disruption element.

The Action states that the language "arranged to result in a void," "manifests a physical treatment," "manifests a locally restricted change in surface energy" etc. are directed toward process of making a void and thus are product by process claim elements and it is the product and not the process that is the claimed subject matter. Applicants respectfully disagree that the claimed elements are product by process claim limitations and that the process (the functions) can be ignored and it is only the resulting structure that is determined for patentability. These so called product by process limitations are not such but, are means plus function elements which are permitted under 35 USC 112, 6<sup>th</sup> paragraph.

In claim 13 the language at issue is:

the disruption element being arranged to result in a void in a second portion of the plurality of layers in the area above the disruption element when the plurality of layers are applied to the first layer including the disruption element

This is not a method step, but a limitation on the structural construction of the disruption element. This disruption element is so constructed that when the subsequent applied layers are applied to the disruption element, a void is created in these subsequently applied layers, the disruption element prevents deposition of later applied layers in the related regions of the associated layer. The means are the disruption element.

The function is to create a void in a subsequently applied layer in the region of the disruption element. The description of the disruption element with this characteristic is a physical description of the disruption element. It has certain characteristics. These characteristics are a property of the disruption element. A claimed element having a claimed property is not a product by process limitation, but a structural description of the material on the basis of its property. This is not a process or methodology, but a structural element. The two should not be confused.

It can equally be shown that the other objected to terms are physical properties of the disruption element and thus are structural and not product by process limitations. For example, "manifests a physical treatment" means that the material exhibits a property wherein the material has received a physical treatment. For example, a roughened surface as disclosed in Murakami is a physical treatment (sandblasting) and is structural. A roughened surface plainly for example is structural. The same is true of the term "manifests a chemical treatment," "a locally restricted change in surface energy," "provides a residue," all provide a description of a property of the disruption element, which property is not a product by process limitation but a structural limitation of the claimed element. The so called products must all have the claimed properties, which are not processes per se as asserted. This basis of the rejection is in error. For the reasons given, claim 13 is believed allowable.

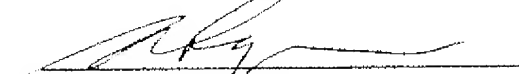
The remaining claims depend from the independent claims, include all of the structure therein and are believed allowable at least for these reasons.

Since applicants have shown claims 2, 3, 14 and 17-24 to be in proper form for allowance, such action is respectfully requested.

The Commissioner is authorized to charge or credit deposit account 03 0678 for any under or over payments in connection with this paper.

February 17, 2009

Respectfully submitted,  
Wolfgang Clemens et al.



by William Squire  
Reg. No. 25,378, Attorney for Applicants

Tel. No.: (973) 994-1700  
Fax No. : (973) 994-1744

327363v5

# Polypropylene

From Wikipedia, the free encyclopedia

**Polypropylene** or **polypropene** (**PP**) is a thermoplastic polymer, made by the chemical industry and used in a wide variety of applications, including packaging, textiles (e.g. ropes, Under Armour, thermal underwear and carpets), stationery, plastic parts and reusable containers of various types, laboratory equipment, loudspeakers, automotive components, and polymer banknotes. An addition polymer made from the monomer propylene, it is rugged and unusually resistant to many chemical solvents, bases and acids.

In 2007, the global market for polypropylene had a volume of 45,1 million tons which led to a turnover of about 65 billion US \$ (47,4 billion €).

## Contents

- 1 Chemical and physical properties
  - 1.1 Degradation
- 2 History
- 3 Synthesis
  - 3.1 Mechanism of metallocene catalysts
- 4 Manufacturing
- 5 Uses
- 6 Recycling
- 7 References
- 8 External links

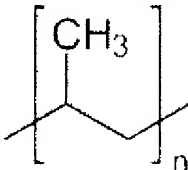
## Chemical and physical properties

Most commercial polypropylene is isotactic and has an intermediate level of crystallinity between that of low density polyethylene (LDPE) and high density polyethylene (HDPE); its Young's modulus is also intermediate. PP is normally tough and flexible, especially when copolymerised with ethylene . This allows polypropylene to be used as an engineering plastic, competing with materials such as ABS. Polypropylene is reasonably economical, and can be made translucent when uncolored but is not as readily made transparent as polystyrene, acrylic or certain other plastics. It is often opaque and/or coloured using pigments. Polypropylene has good resistance to fatigue.

Polypropylene has a melting point of ~160°C (320°F), as determined by Differential scanning calorimetry (DSC).

The MFR (Melt Flow Rate) or MFI (Melt Flow Index) is a measure of PP's molecular weight. This helps to determine how easily the melted raw material will flow during processing. Higher MFR PP's fill the plastic mold more easily during the injection or blow molding production process. As the melt flow increases, however, some physical properties, like impact strength, will decrease.

There are three general types of PP: homopolymer, random copolymer and block copolymer. The

Polypropylene	
	
IUPAC name	<span></span> <span>[show]</span>
Other names	Polypropylene; Polypropene; Polipropene 25 [USAN];Propene polymers; Propylene polymers; 1-Propene
Identifiers	
CAS number	9003-07-0
Properties	
Molecular formula	(C <sub>3</sub> H <sub>6</sub> ) <sub>x</sub>
Density	0.855 g/cm <sup>3</sup> , amorphous 0.946 g/cm <sup>3</sup> , crystalline
Melting point	~ 160 °C
Except where noted otherwise, data are given for materials in their standard state (at 25 °C, 100 kPa) Infobox references	

comonomer used is typically ethylene. Ethylene-propylene rubber or EPDM added to PP homopolymer increases its low temperature impact strength. Randomly polymerized ethylene monomer added to PP homopolymer decreases the polymer crystallinity and makes the polymer more transparent.

## Degradation

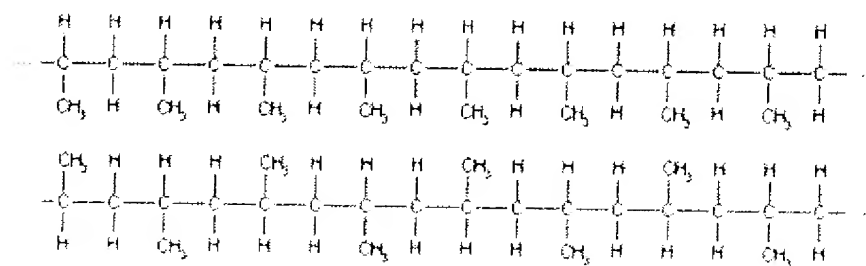
Polypropylene is liable to chain degradation from exposure to UV radiation such as that present in sunlight. For external applications, UV-absorbing additives must be used. Carbon black also provides some protection from UV attack. The polymer can also be oxidised at high temperatures, a common problem during moulding operations. Anti-oxidants are normally added to prevent polymer degradation.

Quaternary ammonium biocides and oleamide were found by researchers to be leaking out of polypropylene plastics used in laboratory experiments, affecting experimental results.<sup>[1]</sup> Since polypropylene is used in a wide number of food containers such as those for yogurt, the problem is being studied.<sup>[2]</sup>

## History

Polypropylene was first polymerized by Dr. Karl Rehn at Hoechst AG in Germany in 1951, who didn't recognize the importance of his discovery. It was then rediscovered on March 11 1954 by Giulio Natta. At first it was thought that it would be cheaper than polyethylene.<sup>[3]</sup>

## Synthesis



Short segments of polypropylene, showing examples of isotactic (above) and syndiotactic (below) tacticity.

An important concept in understanding the link between the structure of polypropylene and its properties is tacticity. The relative orientation of each methyl group (CH<sub>3</sub> in the figure at left) relative to the methyl groups on neighboring monomers has a strong effect on the finished polymer's

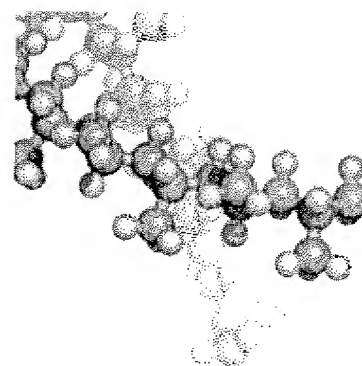
ability to form crystals, because each methyl group takes up space and constrains backbone bending.

Like most other vinyl polymers, useful polypropylene cannot be made by radical polymerization due to the higher reactivity of the allylic hydrogen (leading to dimerization) during polymerization. Moreover, the material that would result from such a process would have methyl groups arranged randomly, so called *atactic* PP. The lack of long-range order prevents any crystallinity in such a material, giving an amorphous material with very little strength and only specialized qualities suitable for niche end uses.

A Ziegler-Natta catalyst is able to limit incoming monomers to a specific orientation, only adding them to the polymer chain if they face the right direction. Most commercially available polypropylene is made with such Ziegler-Natta catalysts, which produce mostly isotactic polypropylene (the upper chain in the figure above). With the methyl group consistently on one side, such molecules tend to coil into a helical shape; these helices then line up next to one another to form the crystals that give commercial polypropylene many of its desirable properties.



More precisely engineered Kaminsky catalysts have been made, which offer a much greater level of control. Based on metallocene molecules, these catalysts use organic groups to control the monomers being added, so that a proper choice of catalyst can produce isotactic, syndiotactic, or atactic polypropylene, or even a combination of these. Aside from this qualitative control, they allow better quantitative control, with a much greater ratio of the desired tacticity than previous Ziegler-Natta techniques. They also produce narrower molecular weight distributions than traditional Ziegler-Natta catalysts, which can further improve properties.



A ball-and-stick model of syndiotactic polypropylene.

To produce a rubbery polypropylene, a catalyst can be made which yields isotactic polypropylene, but with the organic groups that influence tacticity held in place by a relatively weak bond. After the catalyst has produced a short length of polymer which is capable of crystallization, light of the proper frequency is used to break this weak bond, and remove the selectivity of the catalyst so that the remaining length of the chain is atactic. The result is a mostly amorphous material with small crystals embedded in it. Since each chain has one end in a crystal but most of its length in the soft, amorphous bulk, the crystalline regions serve the same purpose as vulcanization.

### Mechanism of metallocene catalysts

The reaction of many metallocene catalysts requires a co catalyst for activation. One of the most common co catalysts for this purpose is Methylaluminoxane (MAO)<sup>[4]</sup>. Other co catalysts include,  $\text{Al}(\text{C}_2\text{H}_5)_3$ <sup>[5]</sup>. There are numerous metallocene catalysts that can be used for propylene polymerization. (Some metallocene catalysts are used for industrial process, while others are not, due to their high cost.) One of the simplest is  $\text{Cp}_2\text{MCl}_2$  ( $\text{M} = \text{Zr}, \text{Hf}$ ). Different catalyst can lead to polymers with different molecular weights and properties. Active research is still being conducted on metallocene catalyst.

In the mechanism the metallocene catalyst first reacts with the co catalyst. If MAO is the co catalyst, the first step is to replace one of the Cl atoms on the catalyst with a methyl group from the MAO. The methyl group on is replaced by the Cl from the catalyst. The MAO then removes another Cl from the catalyst. This makes the catalyst positively charged and susceptible to attack from propylene<sup>[6]</sup>.

Once the catalyst is activated, the double bond on the propene coordinates with the metal of the catalyst. The methyl group on the catalyst then migrates to the propene, and the double bond is broken. This starts the polymerization. Once the methyl migrates the positively charged catalyst is reformed and another propene can coordinate to the metal. The second propene coordinates and the carbon chain that was formed migrates to the propene. The process of coordination and migration continues and a polymer chain is grown off of the metallocene catalyst.<sup>[7][8]</sup>

### Manufacturing

Melt processing of polypropylene can be achieved via extrusion and molding. Common extrusion methods include production of melt blown and spun bond fibers to form long rolls for future conversion into a wide range of useful products such as face masks, filters, nappies and wipes.

The most common shaping technique is injection molding, which is used for parts such as cups, cutlery, vials, caps, containers, housewares and automotive parts such as batteries. The related techniques of blow molding and injection-stretch blow molding are also used, which involve both extrusion and

molding.

The large number of end use applications for PP are often possible because of the ability to tailor grades with specific molecular properties and additives during its manufacture. For example, antistatic additives can be added to help PP surfaces resist dust and dirt. Many physical finishing techniques can also be used on PP, such as machining. Surface treatments can be applied to PP parts in order to promote adhesion of printing ink and paints.

## Uses

Since polypropylene is resistant to fatigue, most plastic living hinges, such as those on flip-top bottles, are made from this material. However, it is important to ensure that chain molecules are oriented across the hinge to maximise strength.

Very thin sheets of polypropylene are used as a dielectric within certain high performance pulse and low loss RF capacitors.

Many plastic items for medical or laboratory use can be made from polypropylene because it can withstand the heat in an autoclave. Its heat resistance also enables it to be used as the manufacturing material of consumer-grade kettles. Food containers made from it will not melt in the dishwasher, and do not melt during industrial hot filling processes. For this reason, most plastic tubs for dairy products are polypropylene sealed with aluminium foil (both heat-resistant materials). After the product has cooled, the tubs are often given lids made of a less heat-resistant material, such as LDPE or polystyrene. Such containers provide a good hands-on example of the difference in modulus, since the rubbery (softer, more flexible) feeling of LDPE with respect to PP of the same thickness is readily apparent. Rugged, translucent, reusable plastic containers made in a wide variety of shapes and sizes for consumers from various companies such as Rubbermaid and Sterilite are commonly made of polypropylene, although the lids are often made of somewhat more flexible LDPE so they can snap on to the container to close it. Polypropylene can also be made into disposable bottles to contain liquid, powdered or similar consumer products, although HDPE and polyethylene terephthalate are commonly also used to make bottles. Plastic pails, car batteries, wastebaskets, cooler containers, dishes and pitchers are often made of polypropylene or HDPE, both of which commonly have rather similar appearance, feel, and properties at ambient temperature.

Polypropylene is a major polymer used in non wovens (see nonwovens). Over 50% being used in diapers or sanitary products where it is treated to absorb water (hydrophillic) rather than naturally repelling water (hydrophobic). Other interesting non woven uses include filters for air, gas and liquids where the fibers can be formed into sheets or webs that can be pleated to form cartridges or layers that filter in various efficiencies in the 0.5 to 30 micron range. Such applications could be seen in the house as water filters or air conditioning type filters. The high surface area and natural hydrophobic polypropylene non wovens are ideal absorbers of oil spills with the familiar floating barriers near oil spills on rivers.

A common application for polypropylene is as **Biaxially Oriented polypropylene (BOPP)**. These BOPP sheets are used to make a wide variety of materials including clear bags. When polypropylene is biaxially oriented, it becomes crystal clear and serves as an excellent packaging material for artistic and retail products.

Polypropylene, highly colorfast, is widely used in manufacturing rugs and mats to be used at home. <sup>[9]</sup>

In New Zealand, in the US military, and elsewhere, polypropylene, or 'polypro' (New Zealand 'polyprops'), has been used for the fabrication of cold-weather base layers, such as long-sleeve shirts or

long underwear. ( More recently, polyester replace polypropylene in these applications in the U.S. military, such as in the ECWCS. <sup>[10]</sup> ) Polypropylene is also used in warm-weather gear such as some Under Armour clothing, which can easily transport sweat away from the skin. These polypropylene clothes are not easily flammable, however, they can melt, which may result in severe burns if the service member is involved in an explosion or fire of any kind.<sup>[11]</sup>

Polypropylene is widely used in ropes, distinctive because they are light enough to float in water.<sup>[12]</sup>

Polypropylene is also used as an alternative to polyvinyl chloride (PVC) as insulation for electrical cables for LSZH cable in low-ventilation environments, primarily tunnels. This is because it emits less smoke and no toxic halogens, which may lead to production of acid in high temperature conditions.

Polypropylene is also used in particular roofing membranes as the waterproofing top layer of single ply systems as opposed to modified bit systems.

Its most common medical use is in the synthetic, nonabsorbable suture Prolene, manufactured by Ethicon Inc.

Polypropylene is most commonly used for plastic moldings where it is injected into a mold while molten, forming complex shapes at relatively low cost and high volume, examples include bottle tops, bottles and fittings.

Recently it has been produced in sheet form and this has been widely used for the production of stationary folders, packaging and storage boxes. The wide colour range, durability and resistance to dirt make it ideal as a protective cover for papers and other materials. It is used in Rubik's cube stickers because of these characteristics.

The availability of sheet polypropylene has provided an opportunity for the use of the material by designers. The light weight, durable and colourful plastic makes an ideal medium for the creation of light shades and a number of designs have been developed using interlocking sections to create elaborate designs.

Polypropylene sheets are a popular choice for trading card collectors; these come with pockets (nine for standard size cards) for the cards to be inserted and are used to protect their condition and are meant to be stored in a binder.


Polypropylene has been used in hernia repair operations to protect the body from new hernias in the same location. A small patch of the material is placed over the spot of the hernia, below the skin, and is painless and is rarely, if ever, rejected by the body.

The material has recently been introduced into the fashion industry through the work of designers such as Anoush Waddington who have developed specialized techniques to create jewellery and wearable items from polypropylene.

Expanded Polypropylene (EPP) is a foam form of polypropylene. EPP has very good impact characteristics due to its low stiffness, this allows EPP to resume its shape after impacts. EPP is extensively used in model aircraft and other radio controlled vehicles by hobbyists. This is mainly due to its ability to absorb impacts, making this an ideal material for RC aircraft for beginners and amateurs.

## Recycling

Polypropylene is commonly recycled, and has the number "5" as its recycling symbol: .

Polypropylene is commonly recycled, and has the number "5" as its recycling symbol: 

## References

- <sup>^</sup> Plastic additives leach into medical experiments, research shows (<http://www.physorg.com/news145545554.html>), Physorg.com, 10 November 2008
- <sup>^</sup> "Researchers raise alarm after chemical leak found in common plastic" (<http://www.theglobeandmail.com/servlet/story/RTGAM.20081107.wchemical07/EmailBNStory/National/home>). [www.theglobeandmail.com](http://www.theglobeandmail.com).  
<http://www.theglobeandmail.com/servlet/story/RTGAM.20081107.wchemical07/EmailBNStory/National/home>. Retrieved on 2008-11-10.
- <sup>^</sup> This week 50 years ago (<http://www.newscientist.com/article/mg19426014.900-this-week-50-years-ago.html>) in New Scientist, 28 April, 2007, p. 15
- <sup>^</sup> R. Kleinschmidt et al. *Journal of Molecular Catalysis A: Chemical*, 157(2000)83–90
- <sup>^</sup> Kyung-Jun Chu. *Eur. Polym. J.* Vol. 34, No. 3/4, pp. 577-580, 1998
- <sup>^</sup> Session 6 (<http://www.chemistry.wustl.edu/~edudev/Designer/session6.html>)
- <sup>^</sup> Song et al. *Macromol. Symp.* 2004, 213, 173-185
- <sup>^</sup> P. Mercandelli et al. *Journal of Organometallic Chemistry* 692 (2007) 4784–4791. [1] (<http://dx.doi.org/10.1016/j.jorganchem.2007.06.021>)
- <sup>^</sup> <http://www.fibersource.com/f-tutor/olefin.htm> Rug fibers
- <sup>^</sup> [http://peosoldier.army.mil/factsheets/SEQ\\_CIE\\_ECWCS.pdf](http://peosoldier.army.mil/factsheets/SEQ_CIE_ECWCS.pdf) ECWCS Gen. III
- <sup>^</sup> USAF Flying Magazine. Safety. Nov. 2002 (<http://permanent.access.gpo.gov/lps11992/2002/fsmnov02.pdf>).
- <sup>^</sup> Rope Materials (<http://www.lehighgroup.com/fiber.htm>)

## External links

- Chain structure of Polypropylene (<http://www.pslc.ws/mactest/pp.htm>)
- Technical Properties & Applications (<http://www.ides.com/generics/PP.htm>)
- Polypropylene is traded on the London Metal Exchange (<http://www.lme.com/5542.asp>)

Retrieved from "<http://en.wikipedia.org/wiki/Polypropylene>"

Categories: Plastics | Polymers | Polyolefins | Dielectrics | Speciality films | Thermoplastics | Packaging materials

Hidden categories: All articles with unsourced statements | Articles with unsourced statements since January 2009

- This page was last modified on 17 February 2009, at 05:41.
- All text is available under the terms of the GNU Free Documentation License. (See **Copyrights** for details.)  
Wikipedia® is a registered trademark of the Wikimedia Foundation, Inc., a U.S. registered 501(c)(3) tax-deductible nonprofit charity.